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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/813,164	03/21/2001	Scott E. Moore	M4065.0187/P187-B	2955
24998	7590	04/23/2004	EXAMINER	
DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP			LEADER, WILLIAM T	
2101 L STREET NW			ART UNIT	
WASHINGTON, DC 20037-1526			PAPER NUMBER	

1742

DATE MAILED: 04/23/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

MP

<b>Office Action Summary</b>	<b>Application No.</b> 09/813,164	<b>Applicant(s)</b> MOORE, SCOTT E.	
	<b>Examiner</b> William T. Leader	<b>Art Unit</b> 1742	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 31 March 2004.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 51-69 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 51-69 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

### DETAILED ACTION

1. The terminal disclaimer filed on March 26, 2004 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of prior patent number 6,217,727 has been reviewed and is accepted. The terminal disclaimer has been recorded.
2. In view of the terminal disclaimer, the nonstatutory double patenting rejection is withdrawn.

### *Claim Rejections - 35 USC § 102*

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 51 and 53 are rejected under 35 U.S.C. 102(b) as being anticipated by Dewallens (4,187,154).
5. The Dewallens patent discloses apparatus for electroplating onto a generally circular, flat workpiece. The workpiece is made from material which has a low

electric conductivity (column 1, lines 10-11). A thin metal layer is deposited on the surface of the workpiece by vaporizing or some other suitable process to provide sufficient electric conductivity to allow electroplating to take place (column 2, lines 45-52). Dewallens teaches that due to the small thickness of the initially applied metal layer, the current strength in the electrolyte between the cathodic workpiece and an opposing anode should be relatively low until some metal has been deposited by electrolysis (column 2, lines 59-64). Then, higher strength electric current is provided to obtain higher working efficiency (column 2, line 65-column 3, line 4). The current may be increased stepwise or continuously as the thickness of the metal electroplated onto the cathode increases (column 3, lines 5-8, 11-12)). The increase in current is brought about by lowering the spacing between the cathodic workpiece and the opposing anode (column 2, lines 1-5; column 3, lines 8-10). The adjustment in current strength may be automated (column 1, lines 61-65).

6. The electroplating of Dewallens is carried out in apparatus which includes container 1, which corresponds to applicant's reservoir. Support 6 is provided to hold the workpiece so that it is in contact with the electrolyte. This support corresponds to applicant's support. One or more anodes 3 are provided as opposing electrodes. This anode corresponds to applicant's recited electrode. Means are provided to move support 6 holding the workpiece to change the distance between the support and opposing anode electrode, thereby changing the strength of

electroplating current. See figures 1 and 2. Thus, all elements recited in instant claims 51 and 53 are taught by Dewallens. The statement of intended use in the preamble of claim 51 does not distinguish the claimed apparatus from that of the prior art. See MPEP 2114.

7. Claims 66-69 are rejected under 35 U.S.C. 102(e) as being anticipated by Simpson et al (6,174,425).

8. The Simpson et al patent is directed to a process and apparatus for electroplating a semiconductor wafer. As shown in figure 3, the apparatus includes cup 32 which serves as a reservoir to hold an electroplating solution. The system includes a head 35 that has a turntable 351 and clamp structures 36 (with clamp portions 362 which serve as cathode contacts) to hold the workpiece. Anode electrode 34 is provided at a first distance away from the workpiece support. Second electrode 37, which serves as a current density modifier, is provided at a second distance away from the workpiece support. Thus, all elements recited in instant claim 66 are taught by Simpson et al.

9. Instant claim 67 recites conductive contacts for holding the substrate to the support. As noted above, clamp portions 362 serve as cathode contacts which hold the substrate. In the prior art apparatus of figure 1, Simpson et al additionally illustrate clamp fingers 152 which serve as the cathode contact and hold the

workpiece on the support. Instant claim 68 recites a cascade-type structure. Page 9, lines 4-6 of applicant's specification state that the tank 12 may be provided with a cascade structure to ensure that fresh solution 14 is made available to the wafer (cathode) 18. This appears to be the only description of a cascade device in the specification. Simpson et al disclose a circulation system in which electroplating solution is supplied through inlet port 312 and flows through diffuser 33 to reach the substrate. These elements of Simpson et al meet the limitations of instant claims 68 and 69.

10. Claim 66 is rejected under 35 U.S.C. 102(b) as being anticipated by Van Raalte et al (3,880,725).

11. The Van Raalte et al patent is directed to electroplating apparatus. As shown in figure 2, the apparatus includes vessel 117 which serves as a reservoir to contain an electroplating solution. Workpiece 112 is supported within the electroplating solution by clamps 122. Electrode 114, made of the plating material, is spaced a first distance from the workpiece. Modifying electrodes 116 are spaced a second distance from the workpiece. Varying the relative electrical potentials at the article 112, the body 114 and each of the modifying electrodes 116 causes differences in electrical potential to be established between the articles 112, the

body 114 and the modifying electrodes (column 4, lines 1-7). All elements recited in instant claim 66 are taught by Van Raalte et al.

***Claim Rejections - 35 USC § 103***

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

13. Claims 52 and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dewallens (4,187,154).

14. Dewallens is taken as above. Claim 52 recites that the electrode is movable relative to the support. Dewallens teaches that the electric current strength is adjusted by varying the spacing between the cathode and the anode (column 3, lines 8-10). This teaching suggests moving either the cathode (workpiece support) or moving the anode (electrode) relative to the other. Dewallens further discloses contact screw 13 for holding the workpiece on the support and providing electric current to the workpiece (column 4, lines 43-45). This corresponds to instant claim 54. Provision of more than one contact would have been obvious because application of current would have been divided between contacts allowing increased current carrying capacity without degrading the workpiece.

15. Claims 55, 56 and 58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dewallens (4,187,154) in view of Okabayashi (4,539,079).

16. Dewallens is taken as above. Claim 55 recites that the reservoir is formed as a cascade-type device. As noted above, page 9, lines 4-6 of applicant's specification state that the tank 12 may be provided with a cascade structure to ensure that fresh solution 14 is made available to the wafer (cathode) 18. The Okabayashi patent is directed to a method and apparatus for electroplating onto a generally flat, circular workpiece as is Dewallens. In figure 1 Okabayashi shows that the electrolyte flows into an intake pipe and is recirculated by pump 6 through an opening 9 in anode holder 2 toward the cathodic workpiece. See column 4, lines 8-14. This structure meets applicant's recitation of a cascade structure as recited in instant claim 55. As the electrolyte is fed under pressure from pump 6 it would be agitated, meeting the limitation of instant claim 56. Okabayashi teaches that a part of the opening 9 is covered with shielding plate 8. This plate would serve as a baffle plate as recited in instant claim 58. The prior art of record is indicative of the level of skill of one of ordinary skill in the art. It would have been obvious at the time the invention was made to have provided apparatus of Dewallens with electrolyte recirculation means such as those shown by Okabayashi because fresh, agitated electrolyte would have been supplied to the workpiece during plating.



17. Claims 55-57 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dewallens (4,187,154) in view of Soby et al (4,269,669).

18. Dewallens is taken as above. Instant claim 57 differs from Dewallens by reciting a diffuser. The Soby et al patent is directed to a method and apparatus for electroplating on a generally flat, circular workpiece as in Dewallens. Soby et al found that the quality of the deposit was degraded by the presence of suspended particles in the electrolyte (column 1, lines 27-31) and proposes an improved electrolyte flow means to overcome this problem. In the apparatus of Soby et al, electrolyte is withdrawn from the electroplating tank through pipe 11. The electrolyte is filtered and recycled (column 3, lines 16-18). The recycled electrolyte is fed into circular tube 7 via feed pipe 8, and is admitted to the interelectrode region 9 through a plurality of inwardly facing holes 10 disposed around the internal circumference of the tube (column 2, lines 55-64). Tube 7 may be considered to be a diffuser as recited in instant claim 57. It would have been obvious at the time the invention was made to have provided apparatus of Dewallens with electrolyte recirculation means such as those shown by Soby et al because fresh, filtered electrolyte free of suspended particles would have been supplied to the workpiece during plating. The apparatus of Soby et al meets the

limitation in claim 55 reciting a cascade-type structure and the limitation in claim 57 reciting agitation.

19. Claims 59-65 rejected under 35 U.S.C. 103(a) as being unpatentable over Dewallens (4,187,154) combined with Gelfand et al (3,186,932).

20. Dewallens is taken as above. Claim 59 differs from Dewallens by reciting a plurality of supports, each configured to hold a substrate, rather than a single workpiece support. The Gelfand et al patent is directed to a method and apparatus for simultaneously electroplating onto a plurality of generally flat, circular workpieces of the type disclosed by Dewallens. As shown in figures 2 and 3, eight cathodic workpiece support assemblies 30 are provided within reservoir 24. In association with each of the cathode assemblies 30, there is positioned an anode assembly generally designated by numeral 116 (column 4, lines 59-62). These anode assemblies correspond to the electrodes recited in instant claim 60. Gelfand et al disclose that the electrolyte is withdrawn from the electroplating tank through tube 76 through pump 104 (column 4, lines 40-43). Electrolyte delivery nozzles are positioned by each of the cathode assemblies such that a flow of electrolyte is directed onto the faces of the workpieces (column 3, lines 59-64). This system meets the limitations of instant claims 64 and 65. Gelfand et al additionally teach that

plating is begun at a relatively low electric current level which is gradually increased as plating proceeds (column 2, lines 46-50).

21. It would have been obvious at the time the invention was made to have provided the electroplating apparatus of Dewallens with a plurality of workpiece supports as shown by Gelfand et al because a number of workpieces could have been simultaneously plated increasing productivity. It would have additionally been obvious to have included electrolyte recirculation means in the apparatus of Dewallens as shown by Gelfand et al because fresh, filtered electrolyte would have been supplied to the workpieces.

22. It would have been obvious at the time the invention was made to have provided the electroplating apparatus of Gelfand et al means to change the spacing between the cathodic workpiece supports and the opposed anode electrodes as taught by Dewallens because the level of current could have been increased during electroplating to increase efficiency and reduce plating time.

23. Claims 51-58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reid et al (6,074,544) or Landau (6,261,433) in view of Dewallens (4,187,154).

24. The Reid et al patent is directed to the electroplating of interconnect metallization onto semiconductor wafers. The wafer is made of an essentially nonconducting material such as silicon. To make the wafer sufficiently conductive

to allow electroplating, a metal seed layer is initially deposited. Because the seed layer is very thin, there is a resistive drop between the points of contact on the edge of the wafer and the center of the wafer (column 1, lines 26-34). Reid et al teach by using a low current at the beginning of the electroplating process, the resistance drop is reduced. When the metal layer has reached the predetermined thickness at which the resistive drop has been reduced to an acceptable level, the current flow can be increased to a second current density. The increase in the current density can be obtained by stepping the current upward in one or more discrete steps or by ramping the current gradually upward (column 2, lines 30-51).

25. Figure 3 of Reid et al depicts apparatus used for electroplating the wafers. The apparatus includes container 42 to contain an electroplating solution. This corresponds to applicant's reservoir. Support structure 33 is provided to hold the wafer. Anode electrode 67 is provided. These elements correspond to applicant's support and electrode. The apparatus recited in instant claim 1 differs from that of Reid et al by reciting that the distance between the electrode and support is changeable.

26. The Landau patent is directed to a system and method for electroplating onto substrates such as semiconductor wafers. The wafer may be made of doped silicon (column 2, lines 33-39). A seed layer 21 provides a conformal layer for even growth of electrodeposited copper thereover (column 3, lines 12-15). A resistive substrate

effect is pronounced during the initial phase of electroplating and reduces the deposition uniformity because the seed layer and initial electroplated layer on the substrate deposition surface are thin. As the deposition layer becomes thicker due to the plating, the resistive substrate effect diminishes because a sufficient thickness of deposited material becomes available to provide uniform current densities across the substrate (column 4, lines 1-17). Because the resistive substrate effect is dominant during the beginning of the plating cycle, a relatively low current density is applied during the initial plating phase. The current density is gradually increased as the deposition thickness increases (column 16, lines 32-39).

27. Figure 2 illustrate apparatus of Landau that may be used to carry out the electroplating process. The apparatus includes container 42 to contain an electroplating solution. Substrate holder 44 is provided to support the workpiece and expose it to the electroplating solution. Copper anode electrode 90 is position within the electroplating solution.

28. The apparatus recited in instant claim 51 differs from that of Reid et al and Landau by reciting that the distance between the electrode and the support is changeable. Dewallens is taken as above and discloses apparatus including means to change the distance between the workpiece support and opposing anode electrode to allow current density to be increased during an electroplating process. It would

have been obvious at the time the invention was made to have provided means to change the distance between the workpiece support and anode electrode in the apparatus of Reid et al and Landau as taught by Dewallens because each of these references teach that it is desirable to increase current density during electroplating and Dewallens teaches that means to change the distance is a straightforward and effective solution to allow the current density to be increased. The broad teaching of Dewallens suggests that either the workpiece support or opposing electrode may be moved as recited in instant claims 52 and 53. As noted above, Dewallens discloses that the support provides electrical contact with the workpiece as recited in instant claim 54. Additionally, Reid et al discloses providing electrical contacts at the edge of the wafer (column 1, lines 29-31); and Landau discloses providing contact fingers 56 (column 6, lines 44-49). With respect to instant claim 55 and 56, both Reid et al and Landau disclose cascade-type plating devices which supply electrolyte under pressure from a pump toward the workpiece. In Landau, the electrolyte inlet is positioned below anode assembly 90 which may be considered to be a diffuser as recited in instant claim 57. In Reid et al shield 69A is positioned between the electrolyte inlet and the workpiece and may be considered to be a baffle plate as recited in instant claim 58.

29. Claims 57 and 58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reid et al (6,074,544) or Landau (6,261,433) in view of Dewallens (4,187,154) as applied to claim 51-58 above, and further in view of Simpson et al (6,174,425).

30. As noted above, claim 57 recites a diffuser while claim 58 recites a baffle plate. These devices are mentioned at page 9, line 6 of applicant's specification but no detailed description is given. Should the anode assembly 90 of Landau not be considered to be a diffuser, and the shield 69A of Reid et al not be considered to be a baffle plate, these features are suggested by Simpson et al. A baffle is defined as "a device to deflect, check, or regulate flow" (Merriam Webster's Collegiate Dictionary, tenth edition). Plate 33 of Simpson et al performs the function of a baffle and, as stated by Simpson et al, of a diffuser. It would have been obvious at the time the invention was made to have included a plate such as that disclosed by Simpson et al in the apparatus of Reid et al or Landau because electrolyte flow would have been more evenly spread across the workpiece.

31. Claims 59-65 are rejected under 35 U.S.C. 103(a) as being unpatentable over Reid et al (6,074,544) or Landau (6,261,433) in view of Dewallens (4,187,154) as applied to claim 51-58 above, and further in view of Gelfand et al (3,186,932) or Katou (5,344,491).

32. Independent claim 59 differs from the apparatus of Reid et al and Landau by reciting a plurality of supports, each configured to hold a substrate, rather than a single workpiece support. Gelfand et al is taken as above to show apparatus with a plurality workpiece supports and opposed anode electrodes. Katou is directed to apparatus for electroplating onto semiconductor wafers. As shown in figure 1 a plurality of plating cups 2, each including a workpiece support member, are provided in bath 14. See column 3, lines 15-18). It would have been obvious at the time the invention was made to have provided a plurality of workpiece supports in the apparatus of Reid et al or Landau because a number of workpieces could have been simultaneously plated increasing productivity.

33. Claims 67-69 are rejected under 35 U.S.C. 103(a) as being unpatentable over Van Raalte et al (3,880,725) in view of the Lowenheim text *Electroplating* and Simpson et al.

34. The Van Raalte et al patent is taken as above. Claim 68 differs from Van Raalte et al by reciting a cascade-type structure which is described in applicant's specification as ensuring that fresh solution is made available to the substrate. The Lowenheim text explains that as metal is deposited on a cathodic workpiece, the electroplating solution in its immediate neighborhood is depleted in metal ions which must be replenished for plating to continue. Lowenheim teaches that metal



ions may be replenished by convection which involves movement of substantial quantities of the electroplating solution relative to the electrodes. See page 139. Simpson et al is taken as above and illustrates apparatus including means for moving solution relative to the electrodes. It would have been obvious to have modified the apparatus of Van Raalte et al by including means for supplying fresh electroplating solution to the workpiece as shown by Simpson et al because depleted metal ions would have been replenished as taught by Lowenheim. Circulation of electroplating solution as shown by Simpson et al would have agitation as recited in instant claim 69. As noted above, Van Raalte et al discloses supporting the workpiece with clamps 122, but does not specifically state that the clamps are conductive contacts as recited in instant claim 67. Simpson et al discloses that the use of conductive clamps (152 in figure 1 and 362 in figure 4) is conventional. Use of such clamps in Van Raalte et al would have been an obvious method for supplying current to the workpiece.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to William T. Leader whose telephone number is 571-272-1245. The examiner can normally be reached on Mondays-Thursdays and alternate Fridays, 7:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy King can be reached on 571-272-1244. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

WL

William Leader  
April 19, 2004

RK

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